Online social networks as a catalyst for software and IT innovation

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ABSTRACT
People have many creative ideas, but only a few of these ideas are realized and lead to innovation. Good ideas often fail because they are not shared between innovators and stakeholders, hence are unlikely to be realized. Consequently, many opportunities are missed to excite customers and to gain a competitive advantage. This paper proposes an innovation process that uses online social networks to lower the hurdle to sharing ideas. The process leverages diffusion effects of social networks while supporting the generation, evaluation, consolidation, and implementation of innovative ideas with lightweight activities. The process is illustrated and discussed using an application example. Although we are focusing on innovation regarding software-intensive systems, we foresee that the discussed process has the potential to be applied to other domains as well.

Categories and Subject Descriptors
D.2.1 [**Requirements/Specifications**]: Elicitation methods.

General Terms
Management, Economics, Human Factors.

Keywords
Creativity, Innovation, Online Social Networks

1. INTRODUCTION
People keep most of their ideas to themselves and forget about them after a while. At most, they write them down and share them with a few close friends or colleagues. In such cases, the innovation process often ends here – apart from a few well-meant comments, the idea doesn't gain any more attention. Interested collaborators are needed to refine or even realize the idea. However, these are difficult to find.

In our previous and ongoing research we have been investigating how to support the documentation and collection of ideas from employees at work [5] and with mobile tool support in situ from end-users [13]. Furthermore, we worked on tools that allow users to capture and deliver situational feedback to an addressee identified from contextual information [12].

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Practical innovation in the field of software-intensive systems is confronted with a large variety of challenges. These challenges affect the whole process from the idea to the product. They lead to lost opportunities for a software company, industry, or even an economy if not addressed adequately. For an innovation process to work well, we recognize the following five requirements. They are based on the experiences we made with the Star Search innovation process in [5].

R1: Ideas need to be good: an idea believed to be good by the inventor does not necessarily find interest by other concerned stakeholders such as users, developers, marketers, and investors.

R2: Ideas need to be shared: ideas cannot be realized in isolation. Many people, however, do not feel motivated enough to share their best ideas or do not know how to share them. It often is not clear with whom, when, and where to share a given idea. In addition, ideas are difficult to express and motivate so that their target audience understands them.

R3: Ideas need to be combined: many ideas from one inventor resemble those from others, but still are just a fragment of a new product or feature. Ideas generated from one perspective, e.g. by a developer, need to be enhanced and combined with others, e.g. a customer, to create value.

R4: Ideas need to be well understood: long-term innovation is riskier than reacting to customer needs and problems. The higher-risk ideas need to be prioritized over lower-risk requirements or be so simple, easy to protect, and attractive that investors for dedicated development can be won.

R5: Ideas need to be selected: implementation requires people, time, and financing. These resources are sparse in comparison to the many ideas that can be generated within short time and effort. Only the best ideas should be realized.

To address these requirements, we propose to use online social networks as a catalyst for innovation. Such networks provide communication channels that allow sharing and discussing ideas with trusted people, groups, and communities at low cost. The social structures and computing capabilities make it easier to identify and involve stakeholders and collaborators. With the attention and cooperation of the right people, ideas are more likely to be realized and make it to the market. We are primarily

interested in ideas regarding software development. However, the overall approach goes beyond software-intensive systems.

This paper proposes an innovation process that utilizes the capabilities and features of online social networks. An application example is used to describe, illustrate, and discuss the process.

The paper is structured as follows: Section 2 presents related work and describes how online social networks can be used for innovation processes. Section 3 introduces and discusses the innovation process. Section 4 concludes and discusses next steps.

2. INNOVATION WITH SOCIAL NETWORKS

Online social networks enable the diffusion of information, ideas, and behavior among their members. Knowing their capabilities and restrictions in these regards facilitates the design of an innovation process that may overcome some of the challenges mentioned before. This section discusses current literature and the implications for using online social networks as a catalyst for innovation.

2.1 Information Diffusion

Kwak et al. scraped the Twitter micro-blogging website and studied users' relationship structure and diffusion behavior of user posts [6]. They found that Twitter's *retweet* mechanism allows users to spread information very far – largely independent of the user's follower count.

This is a very useful property for the process proposed in this paper, as the number of people exposed to ideas is an important parameter for the process.

Sun et al. analyzed data from Facebook to understand how information is diffused in online social networks [14]. They found out that large "viral" chain reactions of diffusion do not start with a single user's post. Instead, it takes several users posting the same information independently from each other to form large diffusion clusters.

This has an implication for social network-based innovation: we cannot rely on the popularity of a single user's idea. For an idea to gain traction in an online social network, multiple users need to post about it. This could for example be achieved by recommending users' ideas to disconnected strangers who might have similar interests or by establishing a service that discovers similarity between posted ideas and brings the respective authors into contact.

Being able to influence information diffusion enables an innovation process to improve sharing of ideas. This addresses requirement (R2) from section 1. It also influences the idea selection process mentioned in requirement (R5), as popular ideas are more likely to spread. As this filters out ideas of lower quality, it also ensures a minimum quality of ideas (R1).

2.2 Behavior Adoption

Centola showed in an experiment that social reinforcement from the contacts of a user significantly increases the likelihood of the user adopting the behavior of her neighbor [3]. Another insight was that behavior spreads faster and further in social networks where users had multiple contacts in common.

Burke, Marlow and Lento came to similar conclusions. Based on data from Facebook, they found out that newcomers are more likely to share content themselves when they see their contacts do the same [2].

When utilizing social networks for innovation processes, influencing the adoption of certain user behaviors may be used to address the sharing requirement (R2) to get more users to share their ideas with each other. Requirement (R3) is about combining ideas and idea fragments of multiple users into new ideas. By motivating users to post more ideas and more comments to existing ideas, this can also be addressed. Finally, requirement (R5), which is concerned with selecting ideas, can also be supported using behavior adoption by motivating users to vote for or against ideas, for example.

2.3 Community Composition

Rogers et al. contrast the *Diffusion of Innovations Model* with the *Complex Adaptive Systems Model* [11] to better understand and predict the diffusion of innovations via real-world social networks. Their example is the *STOP AIDS* campaign of the city of San Francisco that ran from 1984 to 1987 and was reinstated in 1990. Rogers et al. argue that the heterogeneity of social groups plays a crucial role for the diffusion of innovations: according to them, the more diverse a group is, the more likely it is to adopt new ideas. In addition, they claim support from thought leaders of a community to be crucial, as they act as role models and motivate other community members to adopt new ideas or behaviors.

Homophily – the fact that people are more likely to connect with each other the more similar they are – has been shown to exist in offline relationships [9]. Thelwall has shown that this seems to hold true for online social networks as well, using MySpace as the example [15]. Kwak et al. found similar patterns on Twitter [6].

From these works follows that the social network support for innovation should foster the creation of heterogeneous communities to support the adoption of ideas and identify thought leaders to employ their reach. On one hand, this is a challenge for the envisioned process: innovations have been shown to accelerate in heterogeneous groups, which should therefore be more desirable. The design of the process and its tool thus should promote the formation of heterogeneous groups, which might be hard to realize. On the other hand, the existing homophily in online social networks can be used as an advantage when aiming at bringing together people with similar ideas to make them join forces.

With regard to the requirements for innovation from section 1, a heterogeneous community composition helps with requirement (R3): according to the aforementioned literature, the more opinions there are in a community, the more likely it is for some of them to be combined into new ideas or integrated into existing ones. Requirement (R4), which is concerned with the understanding of ideas, is also positively influenced: in a more heterogeneous group, the additional perspectives will help seeing a problem and possible solutions from more angles.

2.4 Summary

Social networks have characteristics that facilitate innovation. The quality (R1) of an idea can be evaluated by analyzing its spread and the reaction of others to the idea. Similar ideas can be identified to help inventors joining their efforts (R3). Target audiences can be reached and ideas be reformulated while they are propagated (R2) to increase their understandability (R4). Stakeholder groups can be identified to find people that complement and enrich ideas and that ultimately can put money and effort into realizing them (R5). Table 1 summarizes the social network capabilities and how they support innovation concerns.

Table 1: Social network capabilities that support innovation.

Social Network Capability	Innovation Concern
Exposure of ideas to many people	Idea sharing; idea filtering and selection
Collaborative content generation	Idea combination and evaluation
Socially reinforced behavior	Adoption of sharing and discussion behaviors
Discussion of ideas	Idea improvement; idea understanding
Integration of heterogeneous people	Idea combination; idea understanding; idea selection
Integration of homogeneous people	Idea combination; idea selection

Recent research in software engineering has started to recognize the power of social networks. For example, Soo Ling Lim et al. use the snowballing technique to identify the network of stakeholders [8]. However, we are not aware of any work that actually uses social networks to drive innovation in software development.

3. ENVISIONED INNOVATION PROCESS

This section describes the envisioned process. Particularly, we discuss the steps we believe to become key assets of an innovation process focused on online social networks. Our aim is to embed this process in an existing online social network, which would provide access to innovators and stakeholders. Through the evaluation by stakeholders, innovative ideas can be improved and will be more likely to be realized. The process covers an idea lifecycle from its creation to its realization. Although the following description of the process is in sequential order, overlaps and iterations may occur.

Step 1 – Idea conception: The first step focuses on the actual conception of the idea and making this idea available via online social networks. Instead of making a note on a sheet of paper, inventors document or upload the idea to an online social network. The tool support for the process will need to motivate them to do so. This corresponds to requirement (R2); section 2 discusses some possible mechanisms to achieve this.

Step 2 – Idea publication: Once the idea exists in the online social network, users may share the idea with their contacts (R2). However, we reserve the right for the inventor of an idea to only share it with selected friends, or even keep the idea private – at least at first. Following the idea of open innovation [4] we are focusing on ideas that are made publicly available. To ensure proper attribution, each idea will always be linked with its inventor and all its significant contributors.

Step 3 – Initial feedback: As soon as the idea is public, contacts of the inventor may comment on the idea, indicate that they "like" it, or simply ignore it. We consider this step to be critical and to be the first hurdle for an idea. This makes sure the most interesting ideas will be worked on (R1, R5).

Step 4 – Idea communication: This step is about the "spreading of the idea" (R2). An idea that is able to draw people's attention to it will be shared with even other people (groups) within an online social network. This might include *retweeting* the idea or using other mechanisms that enable the idea to reach disconnected members of an online social network.

Step 5 – Community building: The people who have interest in an idea will build a group or community around the particular idea. This community will not be limited to friends of the creator, but will include several people who might not know each other but share an interest in the idea.

Step 6 – Idea refinement: In the next step, this community will collaboratively refine the idea (R3). This includes the identification of risks and conflicts, the discussion of options and the agreement on solutions (R4). The community includes the inventor, contributors as well as stakeholders who just expressed interest in the idea. While contributors work on the idea, stakeholders can give feedback on the actual value a solution will provide. At a certain point, either the original inventor or the community as a whole may decide that the idea is clear enough to start further actions.

Step 7 – Realization options: This step focuses on answering how the idea might be realized. This could include identifying organizations, companies that might be willing to realize the idea or the use of crowdfunding platforms [1] to raise money for the realization. Another option could be that one of the group members decides to fund the realization of the idea herself.

3.1 Application Example

In the following paragraphs, we will illustrate each step of the proposed process with a concrete, IT-related example. Furthermore, we will discuss the benefits provided by the process.

(Step 1) Suppose you wish for faster broadband in your area, which unfortunately is currently not provided by your carrier. You just conceived an idea for this new product and enter it into your favorite social network site.

(Step 2) You decide to share your idea with your contacts. Next to the places you visited last summer, your social network profile also highlights your wish for faster broadband, making your idea public.

(Step 3) Tied to your region, your idea is shown to those of your contacts living nearby. Some of them notice it and vote for it. A few even comment on it, which strengthens your idea.

(Step 4) All these contributions are available to your friends' contacts as well, exposing even more people to the idea – it is now spreading through the social network site. At some point, you notice people commenting on the idea that you've never heard of – a community is emerging.

(Step 5) Some of the community's members are very outspoken and passionately help refining your idea, suggesting more details such as certain minimum speeds they require or a maximum price they would be willing to pay. They even come up with new ideas regarding the product such as IPTV and backup services which would be relevant for them but are currently not provided. Others are calmer, but highlighting their support by voting for the idea. Over the course of a few days or even weeks, you get to know several new people from your area through collaboration on your idea – a core group of supporters has formed. Its members, the most active supporters, are listed as co-authors of the idea.

(Step 6) Finally, you believe it is time to consolidate all additional comments and create a final idea that is supported by the community. The social network site provides tools for reaching such a consensus, enabling you to collect the comments that got voted up the most and invite the contributors and supporters of these additions to a final discussion. Together, you formulate a

final version of the idea, documenting the affected area, tolerable price ranges and the most requested connection speeds.

(Step 7) One of your collaborators has a friend working at a broadband provider serving the relevant region. That friend hands over the final version of the idea and a list of all collaborators and supporters to her superior. The company decides demand to be strong enough and begins servicing your area with most of the requested connection speeds within a year. The social network site publishes your success story publicly. This motivates even more people to share their ideas, creating a positive feedback loop among idea communities.

The example presented is a very specific one. Many variations and differing circumstances are possible. For example, no company might be interested in a particular idea – then, someone with sufficient expertise might volunteer for implementing the idea herself or a crowdfunding process could be started. To determine which implementation of the process would be best for a certain idea, we still need to determine appropriate characterization dimensions.

3.2 Discussion

The proposed process provides the following benefits:

- Supporting this process in an existing social network site lowers the hurdles for expressing and communicating ideas.
- It brings together people with similar interests, but also introduces diverse people to each other, adding more heterogeneous viewpoints to ideas.
- The process acts as a catalyst for ideas: while it doesn't help with the initial conception of an idea, it makes all following steps easier.
- Executing the process successfully might result in the realization of ideas, providing more choices to consumers and possibly broadening the offerings of companies.
- Public success stories might create a culture of innovation spanning the whole social network site.

While we have described a simple variant of the process, it might later be refined – for example by having the social network site support restrictions on ideas as to which community members would be invited to participate. This would enable users to post ideas to specific interest groups or organizational units. Additionally, by making authorship explicit and legally binding, one could ensure proper attribution and possibly even monetary compensation for an idea's original inventor.

However, there also are some risks and challenges for the proposed process and for collaborative innovation in general. The following paragraphs discuss some of these issues.

Ownership and trust seem especially challenging when it comes to sharing intellectual achievements such as ideas for new or improved products and services. The public character of the proposed process might inhibit the sharing of truly groundbreaking ideas with lots of financial potential. Fears of perceived losses might be too great.

Therefore, we believe our approach to be especially well suited for smaller improvements to existing systems and services. In particular, ideas for which the value of having it implemented is, for their inventor, greater than their perceived financial potential, seem like a good fit. The ideas from which their inventors hope to realize substantial profits will probably rather be shared and realized with close confidants or in cooperation with a company.

The proposed process uses ratings from users to create a social recommender system. For this to function a critical mass needs to be reached as for small populations, there might not be enough contributions. Nielsen notes that about a tenth of all users make small contributions, and one percent is responsible for the significant contributions [10]. Therefore, about 89 percent of the community will stay passive. While Nielsen does provide some guidelines on how to handle this issue, it still is a challenge for our innovation process.

Finally, a productive and collaborative community culture would be helpful – which is a hard problem that cannot be solved by software engineering methods alone. Yet, we are aware of several works on building communities of practices – e.g., Lave and Wenger [7] – and plan to integrate these into our research.

4. CONCLUSION AND NEXT STEPS

Creative and innovative ideas are a necessity to successfully provide tomorrow's software-intensive systems. However, a lot of these innovative ideas are lost as they are not communicated to the right people at the right time.

This paper proposes an innovation process that is based on and uses the capabilities of online social networks. Particularly, the paper presents preliminary research results, which includes the results of a first literature review as motivation for our work. The key contribution of this paper is the discussion of the envisioned innovation process as a conceptual solution. Furthermore, we illustrate its application with a real-world example and discuss the limitations of the process.

We believe that the drafted process can cope with the challenges described in the introduction. By sharing ideas with people, the social network will work as a social recommender system. Good and relevant ideas will find contributors and the more people believe in and contribute to an idea the likelier it is that such an idea will be realized. We regard the sharing of an idea on such a great scale and using established contacts for discussions and refinements as key success factors for the envisioned innovation process. However, it will still be up to each individual to post an idea, share it with friends and colleagues and refine it with interested collaborators.

We are planning to instantiate the described process using an established online social network (e.g. Twitter, Facebook). Experimenting with this draft process will support its refinement and help us answer the following questions:

- Can ideas spread through an online social network, reaching users not directly connected with the original idea inventor?
- Are ideas able to reach a heterogenic community of supporters using online social networks, or are the supporters of a single idea mostly from the same domain?
- Do ideas spreading through an online social network bring together people that were not connected to each other before?
- Which differences exist between different online social networks in terms of supporting an innovation process and the diffusion behavior of ideas?

The planned evaluations will reveal whether our envisioned process fulfills the requested requirements for an innovation process. If we can show these to hold, we plan to build upon our initial evaluations and investigate further for which application

scenarios our process is suitable. For these scenarios, we will research how the process needs to be parameterized to result in functioning innovation communities.

To achieve this, we are interested in experiments involving closed user groups that, for example, are focused on a specific domain – such as an innovation community on *innovative software for car dashboards* comprised of the employees of an automotive company, providing an industrial context. We are furthermore interested in scenarios involving the general public – like the example in section 3. Our preference for a focus on a specific domain applies here as well, but in addition to companies, scenarios with non-profit organizations or government agencies are also thinkable.

This project is still in its early stages. However, we believe this work will stimulate research that goes beyond the domain of software engineering.

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